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Growth in Medicare Physician Expenditures, 1983-1985: Was PPS a Factor?

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CONTENTS

LIST OF TABLES

I. INTRODUCTION

This paper examines whether Medicare's hospital prospective payment system (PPS) resulted in an increase in Medicare Part B physician expenditures. The PPS system was introduced in 1983 and clearly resulted in a reduction in hospital costs. Hospitals reduced lengths of stay and cost per admission and the payment system is generally regarded as having successfully reduced Medicare Part A outlays (1). It is less clear whether PPS contributed to the large increase in Part B spending that occurred during the same period. During the period immediately following the introduction of PPS (between 1983 and 1985), Medicare Part B expenditures grew by about 15 percent in real terms. While a number of factors could have resulted in this increase (see below), this paper attempts to assess whether part of this increase is in response to the PPS system itself.

In a previous study we have analyzed the effect of the PPS system as well as other factors on Part B spending growth during the 1983-1985 period (2). This analysis looked at all Medicare physician services. In addition, Medicare physician services were disaggregated into five types of service categories (medical care, surgery, radiology, consultations and a residual other category, e.g., largely laboratory and anesthesiology) and four place-of-service categories (inpatient, outpatient, office and other.) This paper extends this analysis by constructing type and place of service combinations, e.g. surgery inpatient, surgery outpatient, radiology inpatient, etc. This allows a more detailed analysis of changes in type and place of service during this period.

The first issue is whether the reductions in lengths of stay and perhaps admission rates that resulted from PPS were associated with simply lower physician services because of fewer inpatient days, more inpatient physician

services to facilitate earlier discharges or a substitution of outpatient and office-based care for inpatient services. The second issue is whether PPS gave hospitals incentives to shift entire services, e.g., radiology, out of the hospital, thus shifting them to Part B of Medicare.

The paper provides both descriptive and econometric analyses. The descriptive analysis examines changes in physician services by several type and place of service combinations. Because of the interest in the issue of whether PPS has resulted in an increase in physician services, we focus attention on comparisons between PPS and waiver states before (1983) and after (1985) the introduction of PPS. These comparisons shed light on the impact of PPS because most of the other factors that may affect volume are likely to have changed in similar ways in all states (including both the PPS and waiver states). This permits us to isolate the effect of PPS because the new hospital payment system occurred only in PPS states, not in the waiver states.

The econometric analysis extends this investigation by controlling explicitly for a large number of other factors through multiple regression techniques. We employ a structural model of the demand for physician services (described elsewhere) estimated with two-stage least-squares procedures. According to our model, the quantity of physician services demanded in an area is a function of a number of area specific variables: the prevailing charge index, area assignment rates for the relevant type of service, the proportion of elderly population with additional insurance coverage, a vector of demographic characteristics that are likely to affect demand, the ratios of specialists and general practitioners to population, average malpractice premiums (for the geographic area), average hospital admission rates and length of stay for the geographic area, a dummy variable representing PPS or waiver status, the number of HMO enrollees per Medicare enrollee, average income from

per capita for the elderly and the ratio of hospital-based physicians to total population, a proxy for the availability of teaching hospitals. A number of variables including prevailing charges, assignment rates, the supply of specialists and general practitioners, admission rates, and lengths of stay are considered to be simultaneously determined with Medicare volume. The two-stage least-squares procedure allows us to correct for the bias that would otherwise exist with ordinary least squares.

The model is used to estimate the effects of PPS on the utilization of physician services between 1983 and 1985 by using the following procedure. We assume that PPS will have both an indirect and direct effect on physician services. The indirect effect emerges from the effect of PPS on inpatient volume—lengths of stay and admission rates—which in turn affect physician use. The direct effect is the effect of PPS on physician services independent of effects through admissions or lengths of stay. We calculate the effect of PPS on admissions and lengths of stay through the estimation of admission and length-of-stay equations and then use instrumental variables for admission and lengths of stay in the physician service equation. The indirect effect of PPS on changes in physician service volume will be the combined effects of PPS on admissions and lengths of stay, each multiplied in turn by the effects of admissions and lengths of stay on service volume. The total effect of PPS on physician services is then the sum of the indirect and direct effects.

We employ a partial adjustment model to analyze the process of change between 1983 and 1985. A partial adjustment model uses cross-sectional variation to analyze the process of change to new equilibrium levels. The determinants of this process can be observed because the effect of the base-year level of the dependent variable level is held constant. Thus, the effect of the PPS can be measured. The results are consistent because the partial

adjustment framework allows the adjustment to equilibrium to begin, it does not require it to be completed.

Partial adjustment models have considerable advantages over first difference or cross-sectional equations in estimating the effect of changes in events such as PPS. In a first difference or pure change model, one implicitly assumes that an adjustment toward an equilibrium has not begun in the time period being observed. The first difference equation picks up the effect of the real change plus random fluctuations in both the dependent and explanatory variables. This explains the low explanatory power frequently observed in such regressions. On the other hand, cross-sectional models are typically not helpful in understanding the impact of changes because they implicitly assume that an adjustment to equilibrium is complete. This is a strong assumption during a short time period in which major changes have taken place. Cross-sectional equations are more likely to capture the correlation between a dependent variable and a policy change such as PPS, not the policy's impact on a new equilibrium.

The previous research cited above used a similar methodological approach; the primary difference was that separate equations were estimated for each type of service and each place of service, but no estimates were made of type-place combinations. The principal results of that study were:

- Admission rates were positively related to the level of volume and intensity for all services. Thus, as a result of declines in admissions between 1983 and 1985, we estimated that total physician expenditures were about 1.2 percent lower in 1985 than they otherwise would have been.

- Length of stay was also positively related to total physician service use. Again, because lengths of stay fell during this period, we estimated that real physician expenditures were 2.0 percent less than they otherwise would have been.

- Medicare's prospective payment system was found to have a slight positive effect on Medicare physician services. We found that PPS had a negative effect on physician services through its effects on lengths of stay and, perhaps, on admissions. But we also found that PPS had an independent positive direct effect on health service utilization. We attributed this to incentives that PPS may have had to increase diagnostic testing, i.e., radiology and laboratory services, in outpatient settings and physicians' offices. The net result was a small increase in Medicare Part B spending.

In the next section, we describe the databases that we have constructed and the analytic methods that will be employed here. After a brief description of changes in Medicare volume and intensity by type and place of service between 1983 and 1985, we then present our econometric results. The final section provides our conclusions.

II. DATA AND METHODS

Data

As with the previous study, we have used data from many different sources to construct comprehensive data files for 1983 and 1985. The principal variables of interest are measures of Medicare utilization and expenditures for each MSA in the United States; similar information has also been compiled for the non-MSA parts of each state (except for Rhode Island, and New Jersey for reasons to be described shortly). The primary advantage of the MSA/non-MSA classification as the unit of analysis is that many variables that could be used to explain cross-sectional variation and growth in utilization and expenditures are available. Another advantage is that the MSA is probably closer to an economic market than the alternatives (e.g., county, Medicare carrier area, state, census division, etc.)

The expenditure and utilization data are drawn from four Medicare data sets. The two most important of these are the 1983 Bill Summary Record (BSR) file and the 1985 BMAD beneficiary file. Each of these files contains detailed information on Medicare services and expenditures for a 5 percent sample of Medicare beneficiaries. The 1983 BSR provides information on numbers of services, allowed charges, and submitted charges and assignment rates for each type and place of service and for each specialty. The 1985 BMAD beneficiary file contains even more detail on specific procedures as well as information on numbers of services, allowed charges, submitted charges and assignment rates for the same types and place of service and specialties. Because the procedure-specific detail available in the 1985 BMAD is not also available on the 1983 Bill Summary Record, we have aggregated the 1985 BMAD data files to be consistent with the BSR. We have then aggregated the Bill Summary Record and BMAD statistics first from the beneficiary to the county level and then to the MSA level. For rural areas, we have aggregated all non-MSA counties within the state. We thus have computed expenditures of Medicare beneficiaries for each of the above-mentioned types and place of service combinations using the 5 percent sample.

The third Medicare data set consists of enrollee counts from the 1983 and 1985 HISKEW Medicare history files. From these, we develop enrollee counts for each county and then for MSAs and for non-MSA parts of each state. Because the BSR and BMAD files contain data on only non-HMO enrollees, we then subtract HMO enrollees taken from HCFA's Average Adjusted Per Capita Cost (AAPCC) files from the overall enrollee totals. Dividing the 1983 BSR data by the adjusted 1983 enrollee counts and the 1985 BMAD data by the adjusted 1985 enrollee counts produces measures of utilization and expenditures on a per enrollee basis by each type and place of service combination for both years. The ratio of HMO

enrollees to total enrollees is also used as a separate variable in the analysis.

The fourth data set consists of indices of Medicare prevailing charges for medical care, surgery, and radiology developed from the 1983 and 1985 Medicare prevailing charge directories. These files contain prevailing charges for up to 100 procedures in each Medicare pricing locality.[1] We have developed indices for medical care, surgery, and radiology for each Medicare pricing locality. The medical care index is used as our price index for consultations. Then enrollee counts for each of the counties within each locality and within each MSA and non-MSA part of each state were used to aggregate these indices into a prevailing charge index for 1983 and 1985 for each MSA and non-MSA part of each state.

With these four data sets we are able to compute Medicare allowed charges per enrollee and a fixed weighted or Laspeyres-type price index for 1983 and 1985. Dividing allowed charges per enrollee by the price index yields a measure of volume/intensity, i.e., real expenditures per enrollee, that differs in important ways from a simple count of services. That is, differences in services per enrollee reflect simple differences in volume, independent of differences in service mix, while real expenditures per enrollee captures both differences in the volume of services and in the mix of services (intensity).

These data sets have some very important limitations, however. One is that only data available by March 1986 is provided to Medicare by each carrier in the 1985 BMAD file. The Bill Summary Record contains similar limitations. If, for example, a carrier provided 90 percent of all claims in 1983, but 85

1. Not all localities provide data on all procedures; thus developing a prevailing charge index for this data set involved making some imputations in order to develop the index. Our procedures for developing these indices are described more fully in Appendix A.

percent of all claims in 1985, the 1983/1985 comparison would understate the actual growth rate. Similarly, coding variations among carriers can result in misclassification of services by type and place of service. The result is that some geographic areas can erroneously over- or underreport particular types and place of service combinations. We systematically examined distributions of data by type and place of service by MSA, as well as changes between 1983 and 1985 to identify geographic areas where data seem to be systematically over- or under-reported. The following areas have been excluded from the study because the data appeared too unreliable to use.

- All of Connecticut, Missouri, West Virginia and Ohio
- Yakima, Washington
- La Crosse, Sheboygan, and Madison, Wisconsin
- Iowa City, Iowa
- Rochester, Minnesota
- Rural New Jersey and Rhode Island

Several other data sets augment these primary files. The HISKEW file allowed us to identify the area proportion of individuals in four age classifications: under 65, 65-74, 75-84, and over 85, as well as the proportion of Medicare beneficiaries in each county that was male or female, and white or nonwhite. We also determined the number who were eligible for Medicare through Old Age Assistance, disability, or renal disease.

The HISKEW file was also used to construct mortality rates which were used as a health status indicator in the regression analysis. We have used the March 1984 and March 1986 versions of the HISKEW files to obtain 1983 and 1985 counts of individuals enrolled in Medicare during the preceding calendar year. This allows us to determine both the number of individuals who were enrolled in

the previous calendar year and the number who died. With this data, we then computed mortality rates for 1982 and 1984 for the Medicare population.

While Medicare data do not contain information on income and private supplementary insurance coverage for the elderly, the Current Population Survey does have this information. The 1984 and 1986 CPSs provide data on 1983 and 1985 income per capita, as well as data on the presence of insurance coverage in addition to Medicare: Medicaid, Group Health, other private health insurance, or CHAMPUS. We have used data from the CPS to impute average income for the elderly and the average proportion of the elderly population with supplementary insurance for each MSA.

The remaining variables used in the analysis were obtained from other sources. Data on hospital characteristics were obtained from the 1983 and 1985 versions of the American Hospital Association's Annual Survey. Data on the availability of physicians were obtained from the American Medical Association's annual surveys. Another variable used in the analysis is the geographic medical economic index (GMEI) constructed by Zuckerman and Welch. This is a weighted price index based on all the major inputs into medical practice (4). Data on malpractice premiums are also included as a measure of area malpractice risk. HCFA has conducted a survey of malpractice carriers since 1975. This survey is used to estimate the change in the average annual premium of a policy providing $100,000/$300,000 of professional liability coverage. This variable was available by state for each of several specialties. Zuckerman and Welch combined malpractice insurance data to obtain average measures at the MSA level.

III. DESCRIPTIVE ANALYSIS

In this section we discuss changes in Medicare real expenditures per enrollee by type and place of service. Table 1 provides the basic results. In the first three columns, results are presented for all states for each type of service and for each site of care. The middle three columns provide the same information for PPS states. The final three columns present the same information for waiver states. The results for all states will be discussed first, followed by a comparison of the PPS and waiver states.

The first finding of note is that real expenditures per enrollee increased by 10.3 percent between 1983 and 1985. Real expenditures on inpatient care fell by 7.5 percent. However, this was offset by a dramatic increase in care provided in outpatient settings (110.0 percent) and care provided in physicians' offices (22.6 percent).

In terms of absolute dollar growth, the most important increases were in expenditures for surgery, which increased in real terms by 11 percent between 1983 and 1985. This increase occurred despite an 11.5 percent decline in inpatient surgery. Surgery provided in hospital outpatient settings increased by almost 200 percent, increasing from $12.62 to $37.40 per enrollee. There is also a substantial increase in surgery provided in physicians' offices (37.9 percent). Surgery also increased in other settings, although this increase is nominally unimportant.

There was also a large increase in real expenditures on radiology between 1983 and 1985. This service had the largest percentage increase overall (24.4 percent). Radiology increased in inpatient settings by 6.9 percent. Radiology increased at a much faster rate in office (31.1 percent) and hospital outpatient settings (52.3 percent). The increase in radiology in inpatient

Table 1

Medicare Real Expenditures Per Enrollee, By Type and Place of Service, 1983-1985

Type & Place of Service	All States 1983	All States 1985	All States Percent Change	PPS States 1983	PPS States 1985	PPS States Percent Change	Waiver States 1983	Waiver States 1985	Waiver States Percent Change
Medical Care									
Inpatient	98.38	91.92	-6.57%	97.73	89.99	-7.92%	104.51	109.39	4.5
Office	79.11	92.29	16.66	78.52	91.09	16.01	84.70	103.05	21.6
Outpatient	6.98	10.05	43.98	7.03	10.00	42.25	6.42	10.50	63.5
Other	8.23	9.55	16.04	8.08	9.29	14.98	9.71	11.95	23.0
Total	192.69	203.81	5.77	191.36	200.37	4.71	205.34	234.89	14.3
Surgery									
Inpatient	146.06	129.22	-11.53%	147.85	129.40	-12.48%	128.98	127.60	-1.0
Office	18.25	25.17	37.92	18.30	25.46	39.13	17.84	22.50	26.1
Outpatient	12.62	37.40	195.35	12.64	38.22	202.37	12.38	29.97	142.0
Other	1.42	5.56	275.68	1.59	5.98	276.10	0.40	1.77	342.5
Total	177.44	196.88	10.96	179.31	198.61	10.76	159.60	181.20	13.5
Radiology									
Inpatient	23.26	24.87	6.92%	23.83	25.20	5.75%	17.81	21.83	22.5
Office	18.63	24.43	31.13	19.18	25.29	31.86	13.48	16.66	23.5
Outpatient	10.15	15.46	52.31	10.24	15.65	52.83	9.29	13.74	47.9
Other	3.88	3.21	-17.27	4.15	3.36	-19.04	1.33	1.83	37.5
Total	53.27	66.28	24.42	54.47	67.64	24.18	41.90	54.03	28.9
Consultations									
Inpatient	13.42	13.96	4.02%	12.98	13.35	2.85%	17.61	19.50	10.7
Office	2.83	3.76	32.86	2.75	3.65	32.73	3.57	4.68	31.0
Outpatient	0.52	0.58	11.54	0.53	0.58	9.43	0.47	0.58	23.4
Other	0.56	0.44	-21.43	0.57	0.43	-24.56	0.41	0.59	43.9
Total	16.78	18.40	9.65	16.22	17.64	8.75	22.06	25.35	14.9
Total									
Inpatient	281.12	259.97	-7.52%	282.39	257.94	-8.66%	268.91	278.32	3.5
Office	118.82	145.65	22.58	118.75	145.49	22.52	119.59	146.89	22.8
Outpatient	30.27	63.49	109.75	30.44	64.45	111.73	28.56	54.79	91.8
Other	14.09	18.76	33.14	14.39	19.06	32.45	11.85	16.14	36.2
Total	440.18	485.37	10.27	441.36	484.26	9.72	428.90	495.47	15.5

settings could be due to more intensive testing to facilitate earlier discharges. It is also likely to be due to the previously described ending of combined billing; that is, beginning in October 1983, physicians were required to bill for the professional component of radiology as a Part B service. At the same time, however, there were strong incentives for hospitals to move services such as radiology completely out of the hospital. Thus, even though there was a small increase in radiology provided in inpatient settings, there was a relative shift toward radiology services provided in physicians' offices and in outpatient settings.

Real expenditures for medical care services increased by 5.8 percent. This was despite a decline of 6.6 percent in medical care services rendered in inpatient settings. This decline is presumably associated with the decline in lengths of stay. Real expenditures for medical care services provided in offices increased by 16.7 percent and in hospital outpatient settings by 44 percent. Consultations increased by 10 percent between 1983 and 1985. Most of the increase occurred in physicians' offices (32.9 percent). There were smaller increases in inpatient and outpatient settings.

The second set of findings are those associated with comparisons between PPS and waiver states. For all four services, Medicare real Part B expenditures grew at a slower rate in PPS states (9.7 percent) than in waiver states (15.5 percent). The most important difference was due to the fact that inpatient services declined by 8.7 percent in PPS states while increasing by 3.5 percent in waiver states. Services provided in physicians' offices grew at comparable rates in PPS and waiver states. However, services in outpatient settings increased at very rapid rates in both sets of states but increased somewhat more in PPS states.

The most important differences between PPS and waiver states occurred in medical care services and consultations. Medical care services grew by only 4.7 percent in PPS states, compared to 14.4 percent in waiver states. Inpatient medical care services declined by 7.9 percent in PPS states, while increasing by 4.6 percent in waiver states. All medical care services provided in other settings (office, outpatient, and other) increased at faster rates in waiver states than in PPS states. Thus, there was no increase in medical care services provided in non-inpatient settings in PPS states to offset the slower rate of growth on the inpatient side.

The story is somewhat the same for consultations. Consultations increased slightly (2.9 percent) in inpatient settings in PPS states, but increased by 10.7 percent in waiver states. There was a substantially faster growth in consultations in outpatient settings in waiver states than in PPS states, while changes in office-based consultations were roughly the same. Thus, the overall impact is slower growth in consultations in PPS states.

Surgery increased slightly faster in waiver states than in PPS states (13.5 percent vs. 10.8 percent); however, the distribution among sites of care was dramatically different. Surgery in inpatient settings declined by 12.5 percent in PPS states, but by only 1.1 percent in waiver states. In contrast, surgery in office-based settings increased by 39.1 percent in PPS states vs. only 26.1 percent in waiver states. Outpatient surgery increased by 202.4 percent in PPS states, but 142.1 percent in waiver states.

A somewhat similar picture is found for radiology. Radiology increased slightly faster (29 percent vs. 24.2 percent) in waiver states. This was largely due to the fact that in PPS states radiology increased by only 5.8 percent in inpatient settings, compared to 22.6 percent in waiver states. Radiology increased faster in office and outpatient settings in the PPS states,

but this was not sufficient to offset the much slower rate of growth in inpatient settings.

IV. ECONOMETRIC ANALYSIS

In this section we discuss the econometric analysis. The results are presented in Tables 2 through 5. We focus the discussion on the hospital utilization variables. The PPS effects are captured in three variables in each of the sets of regression equations. First, PPS clearly had an effect on lengths of stay, and there is some evidence to suggest that PPS also had an effect on hospital admission rates (results are presented elsewhere). In turn, the decline in lengths of stay and admission rates seem to affect physician services. Secondly, over and above the effects of PPS on physician services (through the effects on hospital utilization), an independent effect of PPS on physician service use was also estimated. Thus, in this discussion we concentrate on the admission rate, lengths of stay, and PPS variables. At the end, we summarize the most important findings for other variables.

Table 2 presents the results for medical care services. In this equation, the coefficient on the admission rate is positive and significant. Since admission rates fell over the 1983-1985 period, this result implies that physician services declined in part, because of falling admission rates. The results indicate a strong positive relationship between admission rates and physician services in the inpatient equation. In each of the other equations the admission rate is negatively related to physician service volume. It is only significant in the "other" site-of-care regression. Because the effects of admission rates on care provided in non-inpatient settings is weak or nonexistent, the impact of declining admission rates on inpatient service

Table 2

Regression Results: Medicare Service Volume and Intensity per Enrollee in 1985, by Type and Place of Service

Medical Care

	Total	Inpatient	Office	Outpatient	Other
Intercept	92.91	-112.23	76.50	-17.99	-2.97
	(0.59)	(-1.19)	(1.04)	(-0.94)	(-0.19)
UNDER 65	-109.72	634.43	78.35	-35.02	-25.16
	(-0.15)	(1.41)	(0.22)	(-0.38)	(-0.33)
AGE 65-74	590.18**	563.25***	43.49	41.79	-4.05
	(2.44)	(3.88)	(0.40)	(1.40)	(-0.16)
AGE 75-84	701.78**	703.02***	40.60	-23.24	-35.53
	(2.06)	(3.42)	(0.26)	(-0.56)	(-1.03)
PCT MALE	96.64	75.14	-5.71	-41.92**	-41.80**
	(0.67)	(0.87)	(-0.09)	(-2.39)	(-2.90)
PCT BLACK	-14.86	0.62	-18.19	-6.57**	-1.28
	(-0.54)	(0.04)	(-1.46)	(-1.97)	(-0.46)
MORTALITY	9.60	12.03***	-0.28	1.37	1.99***
	(1.58)	(3.31)	(-0.10)	(1.86)	(3.26)
PCT DISABLED	-248.49	-709.93	-296.82	49.30	49.21
	(-0.32)	(-1.51)	(-0.81)	(0.52)	(0.62)
PCT OAS	-729.86***	-574.38***	-123.65	2.03	28.53
	(-2.79)	(-3.66)	(-1.04)	(0.06)	(1.08)
PREVAILING CHARGE INDEX	-16.34	7.33	-9.05	-10.05***	0.64
	(-1.09)	(0.82)	(-1.33)	(-5.45)	(0.43)
ASSIGNMENT RATE	66.43***	12.36	31.57***	2.49	5.08***
	(4.62)	(1.44)	(5.07)	(1.53)	(3.61)
INSURANCE	0.04	0.05	-0.03	0.02	-0.01
	(0.13)	(0.26)	(-0.22)	(0.42)	(-0.40)
ADMISSION RATE	57.74**	67.71***	-8.83	3.39	-6.37**
	(2.10)	(4.02)	(-0.73)	(1.04)	(-2.36)
LOS	5.00**	5.94***	0.43	0.52**	-0.13
	(2.52)	(4.97)	(0.47)	(2.11)	(-0.66)

Table 2 (continued)

	Total	Inpatient	Office	Outpatient	Other
PPS	-10.20 -1.39	-2.60 (-0.60)	0.09 (0.03)	3.85*** (4.34)	-1.47** (-2.01)
GP/POP	10.98 (0.32)	11.71 (0.56)	-5.68 (-0.36)	0.35 (0.08)	2.14 (0.61)
SPEC/POP	11.72 (1.42)	0.24 (0.05)	3.00 (0.77)	-0.53 (-0.53)	-0.79 (-0.96)
INCOME	0.06E-01*** (3.37)	0.02E-01** (2.06)	0.03E-01*** (3.46)	0.01E-01*** (5.29)	0.01E-02 (0.76)
MALPRACTICE	0.10E-03 (0.16)	-0.07E-02* (-1.89)	0.03E-02 (0.93)	0.08E-03 (1.09)	-0.06E-03 (-1.01)
HMO PER ENROLLEE	3.33 (1.71)	0.70 (0.60)	1.28 (1.43)	0.05 (0.22)	0.10 (0.49)
TEACHING	-15.21 (-1.62)	-11.86** (-2.13)	0.66 (0.15)	1.73 (1.55)	2.18** (2.36)
METRO SMALL	-25.13*** (-3.11)	-17.92*** (-3.70)	-5.68 (-1.54)	-3.85*** (-3.85)	-0.15 (-0.18)
METRO MEDIUM	-12.67* (-1.66)	-10.88** (-2.40)	-4.45 (-1.27)	-2.86*** (-2.99)	-0.64 (-0.84)
METRO LARGE	-9.63 (-1.04)	-9.09 (-1.67)	-5.67 (-1.35)	-2.79** (-2.43)	-1.49 (-1.62)
EXP-1983	0.30*** (6.96)	0.30*** (8.26)	0.73*** (14.42)	0.36*** (5.81)	0.57*** (10.03)
R^2	0.67	0.58	0.80	0.47	0.66
F	24.48	16.94	49.73	10.79	24.00

Note: Variables in italics are instrumental variables estimated using two-stage least squares procedures.

* Significant at .10 level.
** Significant at .05 level.
*** Significant at .01 level.

dominates, resulting in a positive coefficient in the total services regression.

Similarly, lengths of stay are positively and significantly related to physician service use. Again, the length of stay variable has a positive and significant coefficient in the inpatient and outpatient regressions. This suggests that, as lengths of stay decline during this period, fewer physician services were provided in inpatient and outpatient settings. The coefficient on the PPS binary variable in the inpatient equation was negative but not significant. The PPS variable was positive in the outpatient care equation and negative in the other equation. Thus, the results are somewhat contradictory. The conclusion is that PPS did not have an independent effect, that is, other than through hospital utilization, on physician service use.

The results for surgery are presented in Table 3. Admission rates were significantly and positively related to physician service use. The admission rate variable is highly significant in the inpatient equation and is also significant in the outpatient equation. Since admission rates declined during this period, it suggests that there was less surgery provided in inpatient settings and, surprisingly, in outpatient settings as well. Since outpatient surgery increased dramatically during this period, these results may suggest that those increases were unrelated to the decline in admission rates, but rather were exogenously determined, perhaps related to the introduction of new procedures or technologies.

In the total services equation, the length of stay variable was negative and significant at the .10 level. The coefficient on the length of stay variable was positive in the inpatient equation but not significant. However, it was strongly negative and significant in the outpatient and other equations.

Table 3

Regression Results: Medicare Service Volume and Intensity per Enrollee in 1985, by Type and Place of Service

Surgery

	Total	Inpatient	Office	Outpatient	Other
Intercept	8.51 (0.07)	-0.42 (-0.005)	-5.27 (-0.20)	12.47 (0.19)	27.82 (0.66)
UNDER 65	1243.97** (2.16)	956.16** (2.33)	129.75 (1.08)	106.07 (0.34)	72.27 (0.37)
AGE 65-74	734.46*** (4.15)	574.07*** (4.56)	154.02*** (4.16)	-66.87 (-0.70)	74.68 (1.23)
AGE 75-84	1037.25*** (4.04)	712.73*** (3.92)	215.82*** (4.03)	-26.11 (-0.19)	119.45 (1.38)
PCT MALE	323.47*** (2.89)	237.74*** (3.00)	28.01 (1.18)	54.78 (0.92)	-27.55 (-0.72)
PCT BLACK	42.88** (2.05)	13.94 (0.93)	7.43* (1.69)	19.54* (1.72)	4.76 (0.66)
MORTALITY	16.34*** (3.45)	14.01 (4.16)	0.41 (0.41)	5.48** (2.14)	-1.15 (-0.71)
PCT DISABLED	-1538.34** (-2.55)	-1209.68** (-2.82)	-188.60 (-1.50)	-79.34 (-0.24)	-83.83 (-0.41)
PCT OAS	-768.43*** (-3.91)	-607.03*** (-4.35)	-159.39*** (-3.87)	77.68 (0.74)	-75.12 (-1.13)
PREVAILING CHARGE INDEX	-16.89 (-1.61)	-15.93** (-2.18)	5.27 (2.53)	-1.17 (-0.21)	-3.03 (-0.92)
ASSIGNMENT RATE	-14.95* (-1.65)	-29.81*** (-4.75)	2.01 (1.09)	4.53 (0.88)	0.43 (0.14)
INSURANCE	-0.42* (-1.73)	-0.16 (-0.90)	0.07 (1.38)	-0.39*** (-3.02)	-0.07 (-0.82)
ADMISSION RATE	67.39*** (3.19)	62.60*** (4.10)	-0.50 (-0.11)	24.28** (2.15)	4.35 (0.61)
LOS	-2.60* (-1.70)	1.13 (1.04)	-0.09 (-0.29)	-2.58*** (-3.18)	-1.39*** (-2.69)

Table 3 (continued)

	Total	Inpatient	Office	Outpatient	Other
PPS	-3.82 (-0.67)	-6.56 (-1.63)	-0.08 (-0.07)	-0.05 (-0.02)	1.31 (0.68)
GP/POP	-35.13 (-1.34)	-9.12 (-0.49)	-2.31 (-0.41)	-13.40 (-0.95)	2.01 (0.22)
SPEC/POP	1.25 (0.20)	-3.86 (-0.85)	-0.41 (-0.30)	6.46* (1.89)	-4.42** (-2.03)
INCOME	0.01E-01 (1.01)	0.08E-02 (0.87)	0.05E-02* (1.73)	-0.09E-02 (-1.26)	0.08E-02 (1.66)
MALPRACTICE	-0.04E-02 (-0.72)	-0.01E-02 (-0.40)	-0.03E-02*** (-2.58)	-0.01E-01*** (-3.56)	0.08E-02*** (4.43)
HMO PER ENROLLEE	-0.75 (-0.50)	-0.15 (-0.14)	0.04 (0.12)	-0.37 (-0.45)	0.01 (0.01)
TEACHING	-5.01 (-0.70)	3.85 (0.76)	1.36 (0.91)	-11.37*** (-2.96)	2.22 (0.91)
METRO SMALL	2.98 (0.47)	0.88 (0.20)	-0.65 (-0.49)	1.64 (0.49)	0.88 (0.40)
METRO MEDIUM	7.08 (1.19)	2.17 (0.51)	-1.25 (-1.00)	3.05 (0.96)	1.58 (0.79)
METRO LARGE	14.10** (1.96)	7.76 (1.53)	-0.80 (-0.54)	4.41 (1.17)	1.83 (0.78)
EXP-1983	0.38*** (9.05)	0.20*** (5.33)	0.88*** (21.92)	0.79*** (7.14)	0.02 (0.09)
R^2	0.61	0.49	0.82	0.45	0.19
F	18.65	11.65	54.79	9.78	2.81

Note: Variables in italics are instrumental variables estimated using two-stage least squares procedures.

* Significant at .10 level.
** Significant at .05 level.
*** Significant at .01 level.

The implication is that as lengths of stay declined, inpatient surgery was relatively unaffected, but surgery provided in outpatient and other settings increased sharply. This suggests that increases in surgery in outpatient and other settings were associated at least in time with the decline in lengths of stay. It also suggests that there may be a spurious correlation, because the availability of technologies and new procedures may have permitted these services to be provided in outpatient and other settings at the same time that inpatient lengths of stay were declining. The coefficient on the PPS binary variable was insignificant in all equations, suggesting that changes in surgery during this period were not associated with, or at least not correlated with, the introduction of PPS.

In Table 4 the results for radiology are presented. The coefficient on the admission rate is not significant in the total services equation. It is positive and highly significant in the inpatient equation, however, indicating that radiology in inpatient settings declined along with declining admission rates. On the other hand, radiology in outpatient settings seems to have increased in response to declines in admission rates. The coefficient on the length of stay variable was positive and significant in the all-services equation, suggesting the net impact of declines in lengths of stay was a reduction in radiology. The coefficient on the length of stay variable was positive and significant in the inpatient equation.

The PPS binary variable becomes particularly important in the radiology equations. It appears that radiology services in PPS states increased sharply, independent of changes in hospital utilization. The coefficient implies a $13.85 per beneficiary increase independent of changes due to hospital utilization. Surprisingly, the PPS variable is significant and positive in the

Table 4

Regression Results: Medicare Service Volume and Intensity per Enrollee in 1985, by Type and Place of Service

Radiology

	Total	Inpatient	Office	Outpatient	Other
Intercept	-104.68	-33.31	-62.02*	28.49	-5.79
	(-1.48)	(-1.10)	(-1.94)	(1.29)	(-0.55)
UNDER 65	-225.40	215.33	54.89	-221.75**	27.91
	(-0.78)	(1.53)	(0.37)	(-2.18)	(0.58)
AGE 65-74	-32.47	155.81***	45.75	-87.82***	-23.39
	(-0.33)	(3.62)	(1.02)	(-2.85)	(-1.58)
AGE 75-84	-103.80	179.57***	76.71	-186.55***	-23.90
	(-0.73)	(2.86)	(1.20)	(-4.25)	(-1.14)
PCT MALE	229.93***	36.89	88.98***	-1.51	6.06
	(3.71)	(1.41)	(3.09)	(-0.08)	(0.66)
PCT BLACK	-19.26*	-3.04	-4.08	-14.88***	-1.84
	(-1.65)	(-0.60)	(-0.77)	(-4.12)	(-1.08)
MORTALITY	6.04**	4.88***	1.11	0.20	0.87**
	(2.23)	(4.23)	(0.91)	(0.23)	(2.18)
PCT DISABLED	136.09	-241.37*	-88.40	179.92*	-34.40
	(0.40)	(-1.66)	(-0.58)	(1.71)	(-0.69)
PCT OAS	-10.10	-154.63***	-63.34	79.94**	21.47
	(-0.09)	(-3.30)	(-1.30)	(2.39)	(1.34)
PREVAILING CHARGE INDEX	-20.97***	-15.53***	-3.50*	-10.65***	-0.45
	(-4.44)	(-7.31)	(-1.73)	(-6.99)	(-0.68)
ASSIGNMENT RATE	26.18***	10.81***	9.11***	11.01***	1.75**
	(5.14)	(4.98)	(4.01)	(6.27)	(2.35)
INSURANCE	0.32**	0.14**	0.14**	0.01	-0.02
	(2.42)	(2.47)	(2.32)	(0.25)	(-1.11)
ADMISSION RATE	-10.94	7.05***	1.24	-4.33**	-2.33
	(-0.94)	(1.38)	(0.24)	(-1.20)	(-1.36)
LOS	2.05**	1.19***	0.75*	0.20	-0.13
	(2.24)	(3.06)	(1.82)	(0.71)	(-1.00)

Table 4 (continued)

	Total	Inpatient	Office	Outpatient	Other
PPS	13.85***	3.43**	4.26***	4.05***	0.19
	(4.19)	(2.42)	(2.85)	(3.93)	(0.39)
GP/POP	-28.15*	0.43	-12.12*	-5.89	-2.79
	(-1.93)	(0.07)	(-1.83)	(-1.30)	(-1.29)
SPEC/POP	-2.23	-1.20	-1.46	0.22	0.77
	(-0.64)	(-1.80)	(-0.92)	(0.20)	(1.49)
INCOME	0.03E-01***	0.05E-02	0.01E-01***	0.04E-02*	-0.02E-03
	(3.53)	(1.49)	(4.01)	(1.70)	(-0.20)
MALPRACTICE	-0.03E-03	-0.01E-02	-0.10E-03	-0.07E-05	-0.09E-03**
	(-0.11)	(-0.99)	(-0.81)	(0.01)	(-2.46)
HMO PER ENROLLEE	-0.50	-0.02	-0.36	0.35	-0.08
	(-0.59)	(-0.06)	(-0.94)	(1.33)	(-0.61)
TEACHING	4.02	0.27	2.70	-0.38	-0.71
	(1.01)	(0.16)	(1.50)	(-0.31)	(-1.22)
METRO SMALL	0.57	-0.07	-3.45**	0.26	-0.24
	(0.16)	(-0.04)	(-2.13)	(0.24)	(-0.46)
METRO MEDIUM	1.76	0.16	-1.95	-0.007	0.87*
	(0.52)	(0.11)	(-1.26)	(-0.01)	(1.75)
METRO LARGE	7.34*	3.02*	1.25	0.62	1.04*
	(1.82)	(1.79)	(-0.68)	(0.52)	(1.75)
EXP-1983	0.62***	0.24***	1.09***	0.53***	0.64***
	(15.44)	(5.97)	(30.91)	(9.59)	(18.54)
R^2	0.71	0.68	0.86	0.67	0.64
F	30.18	25.49	73.53	25.11	22.02

Note: Variables in italics are instrumental variables estimated using two-stage least squares procedures.

* Significant at .10 level.
** Significant at .05 level.
*** Significant at .01 level.

inpatient equation, meaning that there was more radiology in inpatient settings in PPS states vis-a-vis waiver states, other things equal. The results also indicate substantially greater radiology services provided in office and outpatient settings due to PPS. In our earlier results we reported that the PPS binary variable suggested a shift to office and outpatient settings. That is, hospitals had a strong incentive to reduce the radiology services provided because of the PPS incentives to reduce cost per admission. These results suggest that a more cautious interpretation may be warranted. The positive effect in the inpatient equation suggests that more intensive radiology services may be provided in PPS states perhaps to facilitate earlier discharges. The strong positive coefficients in the office and outpatient settings suggest the possibility of a shift of radiology services out of the hospital. The net effect overall is a positive effect of PPS on provision of radiology services.

Table 5 examines consultation services. The coefficient on the admission rate variable is positive but not significant in the combined-site equation. It is positive and significant in the inpatient equation and significant and negative in the other site of care equation. The results suggest that inpatient consultations declined in response to admission rate declines. The length of stay variable is significant and positive in all of the site-specific equations except for the outpatient equation. The results imply that consultations declined as lengths of stay declined. The PPS coefficient is negative and significant in the all-services equation. This implies that there were fewer consultation services in PPS states than in waiver states, ceteris paribus. The coefficient is significant at the .10 level in the inpatient equation and insignificant in the remaining equations.

Table 5

Regression Results: Medicare Service Volume and Intensity per Enrollee in 1985, by Type and Place of Service

Consultation

	Total	Inpatient	Office	Outpatient	Other
Intercept	-25.18 (-1.22)	-33.03* (-1.92)	0.65 (0.13)	-2.08 (-1.16)	-0.06 (-0.02)
UNDER 65	56.02 (0.57)	52.57 (0.64)	17.70 (0.77)	7.19 (0.83)	-24.64 (-1.61)
AGE 65-74	131.33*** (4.12)	126.78*** (4.75)	7.59 (1.03)	5.34* (1.92)*	-7.89 (-1.60)
AGE 75-84	183.42*** (4.07)	147.62*** (3.93)	19.56* (1.88)	12.38*** (3.16)	-5.36 (-0.77)
PCT MALE	30.03 (1.57)	18.35 (1.16)	1.50 (0.34)	1.88 (1.15)	4.14 (1.41)
PCT BLACK	-4.55 (-1.27)	-3.86 (1.29)	-0.63 (-0.75)	0.55* (1.78)	0.19 (0.35)
MORTALITY	0.85 (1.06)	1.21* (1.83)	-0.19 (-1.00)	0.15** (2.14)	-0.07 (-0.59)
PCT DISABLED	-77.06 (-0.75)	-58.31 (-0.68)	-25.37 (-1.06)	-10.23 (-1.13)	26.71* (1.66)
PCT OAS	-141.42*** (-4.10)	-114.65*** (-3.99)	-14.15* (-1.77)	-7.36** (-2.44)	5.05 (0.95)
PREVAILING CHARGE INDEX	2.82 (1.42)	0.63 (0.38)	0.69 (1.50)	-0.24 (-1.39)	1.34*** (4.30)
ASSIGNMENT RATE	2.01 (1.02)	2.84* (1.68)	-0.15 (-0.38)	0.83*** (5.83)	-0.39 (-1.50)
INSURANCE	0.05 (1.32)	0.06* (1.72)	0.01 (0.61)	0.06E-02 (0.17)	-0.04E-01 (-0.58)
ADMISSION RATE	4.84 (1.36)	6.82** (2.28)	-0.76 (-0.93)	0.11 (0.37)	-1.28** (-2.35)
LOS	1.00*** 3.79	0.92*** (4.21)	0.14** (2.22)	-0.01E-01 (-0.06)	0.16*** (3.84)

Table 5 (continued)

	Total	Inpatient	Office	Outpatient	Other
PPS	-1.99**	-1.37*	0.14	0.08	0.03
	(-2.08)	(-1.72)	(0.62)	(0.91)	(0.20)
GP/POP	-2.52	-1.79	-1.64	0.29	-1.11
	(-0.56)	(-0.48)	(-1.56)	(0.74)	(-1.58)
SPEC/POP	2.05*	1.22	0.51**	0.02	-0.21
	(1.91)	(1.37)	(2.03)	(0.18)	(-1.28)
INCOME	0.05E-02**	0.03E-02*	0.02E-02***	0.04E-03**	-0.08E-03**
	(2.31)	(1.81)	(3.25)	(2.26)	(-2.20)
MALPRACTICE	-0.03E-02***	-0.03E-02***	-0.06E-03***	-0.01E-03	0.05E-04
	(-3.16)	(-4.22)	(-2.86)	(-1.52)	(0.36)
HMO PER ENROLLEE	0.11	-0.05	0.07	0.02E-01	0.04E-01
	(0.45)	(-0.24)	(1.10)	(0.07)	(0.10)
TEACHING	-1.07	-1.07	-0.29	-0.08E-01	0.72***
	(-0.88)	(-1.05)	(-1.04)	(-0.07)	(3.81)
METRO SMALL	-2.54**	-2.07**	-0.70***	-0.09	0.37**
	(-2.40)	(-2.35)	(-2.85)	(-1.03)	(2.19)
METRO MEDIUM	-2.01**	-1.41*	-0.77***	-0.03	-0.05
	(-2.01)	(-1.69)	(-3.32)	(-0.32)	(-0.31)
METRO LARGE	-1.50	-0.80	-0.95***	-0.01	0.02
	(-1.22)	(-0.78)	(-3.41)	(-0.32)	(0.09)
EXP-1983	0.68***	0.64***	1.11	0.35	0.32***
	(20.00)	(20.09)	(28.28)	(8.39)	(7.50)
R^2	0.89	0.87	0.93	0.46	0.67
F	93.81	81.61	170.82	10.21	24.47

Note: Variables in italics are instrumental variables estimated using two-stage least squares procedures.

* Significant at .10 level.
** Significant at .05 level.
*** Significant at .01 level.

Other Results

Results for other variables were reported in detail in a previous report (2). This section will only summarize the most important findings. In the medical care equations, the coefficient on the assignment rate is positive and significant in the office and other sites of care equations, and significant overall. This implies that as assignment rates increased dramatically over this period, reducing the out-of-pocket costs of beneficiaries, medical services increased. On the other hand, the coefficient on the assignment rate is negative and significant in the surgery equation. It is strongly negative and significant in the inpatient surgery equation. This is a perplexing result and seems to suggest that physicians are willing to provide less surgery as assignment rates decline. This seems somewhat inconsistent with interpreting the assignment rate coefficient as a demand response in the other equations. The coefficient on the assignment rate is positive and significant in all of the radiology equations. The implication is that, as out-of-pocket costs decline, radiology services in all settings increase. The assignment rate coefficient is positive but not significant in the overall consultation equation, but it is significant in the inpatient, office, and outpatient settings.

The income coefficient is positive and significant in most equations. It is significant in the overall medical care equation, and for the inpatient, office, and outpatient settings. It is not significant in the surgery equations. It is positive and significant in the overall radiology equation and for the office and outpatient settings. It is significant and positive in consultation equations in each site of care equation. The income elasticities are generally in the .25 to .55 range. These elasticities are substantially higher than those reported in the literature (3). We tend to interpret these

findings as a technology effect. While we attempted to control for technology through other variables (presence of teaching hospitals in the area, specialists per capita, etc.), it appears that technology may be incorporated predominantly in the income variable. This implies that newer procedures and technologies are adopted sooner in higher income areas than elsewhere.

Other important findings are the negative effects of high malpractice premiums emerging in the surgery equations for office, outpatient, and other site of care. This suggests that certain kinds of surgical procedures are less likely to be done where malpractice rates are high. Finally, we found that the 85 and over population was less likely to use medical care services, surgery, and consultations than younger elderly persons.

V. CONCLUSIONS

The regression equation estimates presented in section IV allow us to draw conclusions about the effects of PPS on the four services that we have examined. The estimated effects of PPS on physician services derive from the direct and indirect effects that were described earlier. In Table 6 we present the net impacts of both the direct and indirect effects.

As in our previous work, we assess the impact of PPS under two different sets of assumptions. The first assumption is that, based on our regression estimates (reported elsewhere), PPS had no effect on admission rates but reduced lengths of stay by 14.7 percent. That is, the decline in admission rates that occurred during the early years of PPS were not due to the introduction of the prospective payment system, while much of the large reduction in lengths of stay was attributable to PPS; this is consistent with the strong incentives that hospitals face to reduce cost per admission. Our

Table 6

Percentage Change in Medicare Physician Services
Due to PPS

	Assumption 1[a]			Assumption 2[b]		
	Inpatient	All Outpatient	Total	Inpatient	All Outpatient	Total
Medical Care	-10.0%	-1.5%	-7.8%	-8.8%	-0.8%	-7.3%
Surgery	-5.3	6.5	-0.2	-6.3	3.1	-1.8
Radiology	7.3	33.7	29.1	9.1	37.0	33.2
Consultation	-19.5	-10.0	-18.1	-17.2	-6.9	-15.7
Summary	-6.5	5.4	-1.8	-6.3	4.5	-2.0

a. Assumption 1: Medicare Lengths of Stay fell by 14.7% due to PPS as estimated by U.I. regression model. PPS had no statistically significant effect on admission rates.

b. Assumption 2: Medicare Lengths of Stay fell by 7.8% and admission rates by 9.2% due to PPS, based on reported HCFA data.

second assumption is based on HCFA data that show that PPS states experienced greater reductions in lengths of stay and admissions than did waiver states. The raw differences between PPS and waiver state experience suggests that admission rates may have declined by 9.2 percent and lengths of stay by 7.8 percent more in PPS than waiver states. Thus, the results presented under Assumption 2 in Table 6 reflect these estimates.

The overall results are similar for Assumption 1 and Assumption 2. Both Assumption 1 and Assumption 2 use the estimates described above on changes in lengths of stay and admissions and then add the direct PPS effect as reported in the regression equations in the previous section. The impacts reported in Table 6 reflect both the impacts through changes in hospital utilization and the direct PPS effect. Under Assumption 1, real expenditures on inpatient care fell by 6.5 percent due to the PPS. This was largely due to declines in medical care and radiology. A large increase (7.3 percent) in radiology was not sufficient to offset the declines in medical care and consultations. On the outpatient side (which includes office, hospital outpatient, and other sites), there were declines in consultations and in medical care but increases in surgery (6.5 percent) and in radiology (33.7 percent). The net result is a 5.4 percent increase in care provided in outpatient settings. The net effect overall is a decline in real expenditures on physician services of 1.8 percent. This occurs because the decline in medical care services (7.8 percent) and in consultations (18.1 percent) offset the increase in radiology of 29.1 percent. The results under Assumption 2 are remarkably similar. The net effect was a 2.0 percent decline due to PPS.

These effects are slightly different than reported in our previous paper. That paper included a residual "other" type of service category which behaved largely in the same direction as the radiology results reported here. This

residual category included largely anesthesiology and laboratory services. Since the incentives to increase laboratory services were similar to that for radiology, this would explain the small positive effect of PPS reported in that paper. Thus, when one looks at just these four types of services, it appears that PPS resulted in a reduction in physician services; that is, the volume of physician services was lower than it otherwise would have been had PPS not been introduced.

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